REMARKS

This patent application presently includes claims 5-7, 11-14, 16 and 17, all of which stand rejected under 35 U.S.C. § 102(a) as anticipated by the Chen et al. Article.

In traversing this rejection, the undersigned noted that:

> [I]n accordance with the claims, the present invention involves deriving *distributions* of data obtained from physical measurements and deconvolving overlapping portions of such *distributions*. There is not the slightest suggestion in Chen that any derived data *distributions* might overlap, that deconvolving overlapping portions should be performed, or that it would be of any benefit. Accordingly, Chen does not teach or suggest primary features of the present invention and could not anticipate or render the present invention obvious. (Emphasis added)

In response, the Examiner argued:

> The Applicants state that Chen et al. does not show the claimed step of deconvolving overlapping *data*. Chen et al. shows a method of resolving levels of two differently labeled fluorescent probes from the same location of an array after hybridization of two probes to the array. Chen et al. therefore deconvolves *data* consisting of the levels of two probes that physically overlap on the array. The claimed method is not interpreted to require more than that . . . (Emphasis added)

Thus, the Examiner misinterprets the claims and takes the position that because Chen et al. discloses the step of deconvolving overlapping data, it somehow anticipates the invention. However, the claims recite the step of:

> Deconvolving overlapping portions of *distributions* (emphasis added).

Moreover, from the language of the claim, the Examiner will appreciate that the distributions relate to the step of "deriving distributions of data obtained from physical measurements." A distribution of data is not the same thing as the data itself.

The McGraw-Hill Dictionary of Scientific and Technical Terms (Fifth Edition) defines distribution in the statistical context (our context) as:

> For a discrete random variable, a function (or table) which assigns to each possible value of the random variable the probability that this value will occur.

The fact that two particular measurements on different probes overlap says absolutely nothing about the characteristics of their *distributions*.

There is not the slightest suggestion in Chen et al. that any derived data *distributions* might overlap, that deconvolving overlapping portions should be performed, or that it would be of any benefit. The fact that two samples might overlap has absolutely no significance in this regard.

Furthermore, referring to pages 369-370 of Chen, it is clear that all of the samples are assumed to have the same probability distribution. There is not the slightest suggestion that samples might, from two distributions which need to be deconvolved.

In addition, convolution is not simply overlapping. For the Examiner's information, the undersigned is providing a copy of an internet page in which convolution is defined. Specifically, convolution is an operation which is performed between two *functions* and it produces a third function. This third function represents the overlap between the first function and the reverse, translated version of the second function. The definition provided notes that a convolution is a "kind of very general moving average." So, the invention deconvolves a moving average of an overlapping portion of two distributions.

Thus, knowing that two samples overlap tells us nothing about their probability distributions (functions), tells us nothing about whether the samples have probability distributions which are convolved, and certainly does not provide the slightest suggestion that the deconvolution operation be performed on the joint distribution of two variables to achieve anything of value.

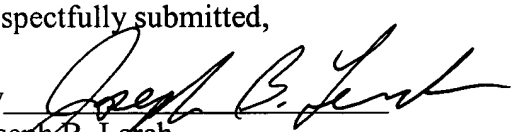
It is respectfully requested that the Examiner give careful consideration to the preceding discussion. If he intends to persist in this rejection, it is requested that he specifically point out where in Chen there is the slightest suggestion of *distributions* needing to be convolved.

With all respect, the undersigned is trying to avoid the need to prepare and file an Appeal Brief, only to have the Examiner withdraw the rejection at that time.

Applicant's attorney has made every effort to demonstrate that this patent application is in condition for allowance. It is therefore earnestly requested that the application, as a whole, receive favorable reconsideration and that all of the claims be allowed as presently constituted. Should there remain any unanswered questions, the examiner is requested to call the applicant's undersigned attorney at the telephone number given below.

Dated: October 22, 2004

Respectfully submitted,

By 

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McGraw-Hill Dictionary of Scientific and Technical Terms

Fifth Edition

Sybil P. Parker
Editor in Chief

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Montreal New Delhi San Juan Singapore Sydney Tokyo Toronto

tress calls, generally by international agreement; for ships at sea and aircraft over the sea, it is 500 kilohertz. { dəˈstres ˌfrē·kwən·sē }

distress signal [COMMUN] An international signal used when a ship, aircraft, or other vehicle is threatened by grave and imminent danger and requests immediate assistance; examples are special radiotelegraph and radiotelephone signals or special signal flags or flares. { dəˈstres ˌsig·nəl }

distributary [HYD] An irregular branch flowing out from a main stream and not returning to it, as in a delta. Also known as distributary channel. { dəˈstrib·yəˌter·ē }

distributary channel *See* distributary. { dəˈstrib·yəˌter·ē ˌchan·əl }

distributed amplifier [ELECTR] A wide-band amplifier in which tubes are distributed along artificial delay lines made up of coils acting with the input and output capacitances of the tubes. { diˈstrib·yəd·əd ˈam·pləˌfī·ər }

distributed capacitance [ELEC] Capacitance that exists between the turns in a coil or choke, or between adjacent conductors or circuits, as distinguished from the capacitance concentrated in a capacitor. { diˈstrib·yəd·əd kəˈpas·əd·əns }

distributed circuit [ELECTR] A film circuit whose effective components cannot be easily recognized as discrete. { diˈstrib·yəd·əd ˈsər·kət }

distributed collector [ENG] A component of a solar heating system comprising a series of modular focusing collectors that are interconnected with an absorber pipe network to carry the working fluid to a heat exchanger. { diˈstrib·yəd·əd kəˈlek·tər }

distributed communications [COMMUN] Information transfer beyond the local level that may involve the originating source to transmit information to all communications centers on any one network, and may also cause an interchange of communications among several whole networks. { diˈstrib·yəd·əd kəˈmyü·nəˈkā·shənz }

distributed constant [ELECTROMAG] A circuit parameter that exists along the entire length of a transmission line. Also known as distributed parameter. { diˈstrib·yəd·əd ˈkän·stənt }

distributed control system [CONT SYS] A collection of modules, each with its own specific function, interconnected tightly to carry out an integrated data acquisition and control application. { diˈstrib·yəd·əd kənˈtrōlˌsis·təm }

distributed database [COMPUT SCI] A database maintained in physically separated locations and supported by a computer network so that it is possible to access all parts of the database from various points in the network. { diˈstrib·yəd·əd ˈdad·əˌbās }

distributed-emission photodiode [ELECTR] A broad-band photodiode proposed for detection of modulated laser beams at millimeter wavelengths; incident light falls on a photocathode strip that generates a traveling wave of photocurrent having the same wave velocity as the transmission line which the photodiode feeds. { diˈstrib·yəd·əd əˈmish·ənˌfōd·ōˌdī·ōd }

distributed fault *See* fault zone. { diˈstrib·yəd·əd ˌfôlt }

distributed free space [COMPUT SCI] Empty spaces in a data layout to allow new data to be inserted at a future time. { diˈstrib·yəd·əd ˈfrē ˈspās }

distributed inductance [ELECTROMAG] The inductance that exists along the entire length of a conductor, as distinguished from inductance concentrated in a coil. { diˈstrib·yəd·əd inˈdək·təns }

distributed intelligence [COMPUT SCI] The existence of processing capability in terminals and other peripheral devices of a computer system. Also known as distributed logic. { diˈstrib·yəd·əd inˈtel·ə·jəns }

distributed logic *See* distributed intelligence. { diˈstrib·yəd·əd ˈläj·ik }

distributed logic cluster word processor [COMPUT SCI] A system of word processors each of which can operate independently, although printers are generally shared by a number of terminals. { diˈstrib·yəd·əd ˈläj·ikˌkläs·tər ˈwərd ˌpräsˌes·ər }

distributed network [COMMUN] A communications network in which there exist alternative routings between the various nodes. [COMPUT SCI] A computer network in which at least some of the processing is done at individual work stations and information is shared by and often stored at the work stations. { diˈstrib·yəd·əd ˈnetˌwərk }

distributed numerical control [CONT SYS] The use of central computers to distribute part-classification data to machine tools which themselves are controlled by computers or numerical control tapes. { diˈstrib·yəd·əd nüˈmer·ə·kəl kənˈtrōl }

distributed parameter *See* distributed constant. { diˈstrib·yəd·əd pəˈram·əd·ər }

distributed-parameter system *See* distributed system. { diˈstrib·yəd·əd pəˈram·əd·ər ˌsis·təm }

distributed paramp [ELECTR] Paramagnetic amplifier that consists essentially of a transmission line shunted by uniformly spaced, identical varactors; the applied pumping wave excites the varactors in sequence to give the desired traveling-wave effect. { diˈstrib·yəd·əd ˈparˌamp }

distributed processing system [COMPUT SCI] An information processing system consisting of two or more programmable devices, connected so that information can be exchanged. { diˈstrib·yəd·əd ˈpräsˌes·iŋ ˌsis·təm }

distributed system [SYS ENG] A system whose behavior is governed by partial differential equations, and not merely ordinary differential equations. Also known as distributed-parameter system. { diˈstrib·yəd·əd ˈsis·təm }

distributing frame [ELECTR] Structure for terminating permanent wires of a central office, private branch exchange, or private exchange, and for permitting the easy change of connections between them by means of cross-connecting wires. { diˈstrib·yəd·iŋ ˌfrām }

distributing point [ORD] Point at which supplies, obtained from the supply point by a division or other unit, are broken down for immediate distribution to subordinate units. { diˈstrib·yəd·iŋ ˌpȯint }

distributing roller [GRAPHICS] A rubber-covered roller whose function is to deliver ink from the supply reservoir to the ink drum of the printing press. { diˈstrib·yəd·iŋ ˌrōl·ər }

distributing terminal assembly [ELECTR] Frame situated between each pair of selector bays to provide terminal facilities for the selector bank wiring and facilities for cross-connection to trunks running to succeeding switches. { diˈstrib·yəd·iŋ ˈtərm·ən·əl əˌsem·blē }

distribution [IND ENG] All activities that involve efficient movement of finished products from the end of the production line to the consumer. [MATH] An abstract object which generalizes the idea of function; used in applied mathematics, quantum theory, and probability theory; the delta function is an example. Also known as generalized function. [STAT] For a discrete random variable, a function (or table) which assigns to each possible value of the random variable the probability that this value will occur; for a continuous random variable x, the monotone nondecreasing function which assigns to each real t the probability that x is less than or equal to t. Also known as distribution function; probability distribution; statistical distribution. { ˌdis·trəˈbyü·shən }

distribution amplifier [ELECTR] A radio-frequency power amplifier used to feed television or radio signals to a number of receivers, as in an apartment house or a hotel. [ENG ACOUS] An audio-frequency power amplifier used to feed a speech or music distribution system and having sufficiently low output impedance so changes in load do not appreciably affect the output voltage. { ˌdis·trəˈbyü·shən ˈam·pləˌfī·ər }

distribution box [CIV ENG] In sanitary engineering, a box in which the flow of effluent from a septic tank is distributed equally into the lines that lead to the absorption field. { ˌdis·trəˈbyü·shən ˈbäks }

distribution cable [ELEC] Cable extending from a feeder cable into a specific area for the purpose of providing service to that area. { ˌdis·trəˈbyü·shən ˌkā·bəl }

distribution center [ELEC] In an alternating-current power system, the point at which control and routing equipment is installed. { ˌdis·trəˈbyü·shən ˌsen·tər }

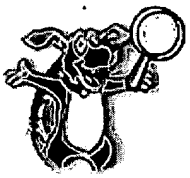
distribution coefficient [OPTICS] One of the tristimulus values of monochromatic radiations having equal power, usually denoted by x, y, z. [PHYS CHEM] The ratio of the amounts of solute dissolved in two immiscible liquids at equilibrium. { ˌdis·trəˈbyü·shən ˌko·iˈfish·ənt }

distribution control *See* linearity control. { ˌdis·trəˈbyü·shən kənˈtrōl }

distribution curve [STAT] The graph of the distribution function of a random variable. { ˌdis·trəˈbyü·shən ˈkərv }

distribution deck [COMPUT SCI] A card file which duplicates all or part of a master card file and used for disseminating or decentralizing. { ˌdis·trəˈbyü·shən ˌdek }

distribution factor [NUCLEO] A term used to express the



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Categories: Computer vision

Convolution

In mathematics and in particular, functional analysis, **convolution** is a mathematical operator which takes two functions *f* and *g* and produces a third function that in a sense represents the amount of overlap between *f* and a reversed and translated version of *g*. A convolution is a kind of very general **moving average**, as one can see by taking one of the functions to be an indicator function of an interval.

Contents [hide]

Uses

Convolution and related operations are found in many applications of engineering and mathematics.

- In statistics, as noted above, a weighted moving average is a convolution.
- In statistics, the probability distribution of the sum of two random variables is the convolution of each of their distributions.
- In optics, many kinds of "blur" are described by convolutions. A shadow (e.g. the shadow on the table when you hold your hand between the table and a light source) is the convolution of the shape of the light source that is casting the shadow and the object whose shadow is being cast. An out-of-focus photograph is the convolution of the sharp image with the blur circle formed by the iris diaphragm.
- In acoustics, an echo is the convolution of the original sound with a function representing the various objects that are reflecting it.
- In electrical engineering and other disciplines, the output of a (stationary, or time- or space-invariant) linear system is the convolution of the input with the system's response to an impulse.
- In physics, wherever there is a linear system with a "superposition" principle, a convolution operation makes an appearance.

Definition

The convolution of *f* and *g* is written *f* * *g*. It is defined as the integral of the product of the two functions after one is reversed and shifted.

$$(f * g)(t) = \int f(\tau)g(t-\tau)\,d\tau$$

The integration range depends on the domain on which the functions are defined. In the case of a finite integration range, *f* and *g* are often considered to extend periodically in both directions, so that the term $g(t - \tau)$ does not imply a range violation. This use of periodic domains is sometimes called a **cyclic**, **circular** or **periodic convolution**. Of course, extension with zeros is also possible. Using zero-extended or infinite domains is sometimes called a **linear convolution**, especially in the discrete case below.

If *X* and *Y* are two independent random variables with probability densities *f* and *g*, respectively, then the probability density of the sum *X* + *Y* is given by the convolution *f* * *g*.

For discrete functions, one can use a discrete version of the convolution. It is then given by

$$(f * g)(m) = \sum_{n} f(n)g(m-n)$$

When multiplying two polynomials, the coefficients of the product are given by the convolution of the original coefficient sequences, in this sense (using extension with zeros as mentioned above).

Generalizing the above cases, the convolution can be defined for any two integrable functions defined on a locally compact topological group. A different generalization is the convolution of distributions.

Properties

The various convolution operators all satisfy the following properties:

Commutativity:

$$f * g = g * f$$

Associativity:

$$f * (g * h) = (f * g) * h$$

Distributivity:

$$f * (g + h) = (f * g) + (f * h)$$

Associativity with scalar multiplication:

$$a(f * g) = (af) * g = f * (ag)$$

for any real (or complex) number *a*.

Derivation rule:

$$\mathcal{D}(f * g) = \mathcal{D}f * g = f * \mathcal{D}g$$

where D*f* denotes the derivative of *f* or, in the discrete case, the difference operator $Df(n) = f(n+1) - f(n)$.

Convolution theorem:

$$\mathcal{F}(f * g) = \sqrt{2\pi}(\mathcal{F}f) \cdot (\mathcal{F}g)$$

where F *f* denotes the Fourier transform of *f*. This theorem also holds for the Laplace transform.

Convolutions on groups

If *G* is a suitable group endowed with a measure *m* (for instance, a locally compact Hausdorff topological group with the Haar measure) and if *f* and *g* are real or complex valued m-integrable functions of G, then we can define their convolution by

$$(f * g)(x) = \int_G f(y)g(xy^{-1})\,dm(y)$$

In this case, it is also possible to give, for instance, a Convolution Theorem, however it is much more difficult to phrase and requires representation theory for these types of groups and the Peter-Weyl theorem of Harmonic analysis. It is very difficult to do these calculations without more structure, and Lie groups turn out to be the setting in which these things are done.

See also

- Deconvolution

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